

Surgical Management of Quadriceps Contracture

Dr. Shivaprasad M S¹, Dr. Yashavantha Kumar C², Dr. Ravikumar T V³, Dr. Shreel Koirala⁴

¹Associate Professor (Orthopaedics), M S Ramaiah Medical College, Bangalore, India

²Assistant Professor (Orthopaedics), M S Ramaiah Medical College, Bangalore, India

³Assistant Professor (Orthopaedics), M S Ramaiah Medical College, Bangalore, India

⁴Junior Resident (Orthopaedics), M S Ramaiah Medical College, Bangalore, India

Abstract: *Introduction: Quadriceps contracture is a common condition where quadriceps is contracted due to various causes. The contracture may occur in one or more components of the muscle. Since the quadriceps femoris is the main active extensor of the knee, contracture of this muscle causes extension contracture of the knee thereby producing a stiff extended knee wherein the muscle fails to elongate enough to allow flexion. This results in severe disability and hence it is important to obtain as much as flexion as possible without impairing the extending power of the quadriceps muscle. Materials and Methods: Our study included 20 patients with quadriceps contracture. Thompson's quadricepsplasty alone was done in 6 cases and Thompson's quadricepsplasty plus Bennet's V-Y plasty done in 14 cases. The procedure was done depending upon the structures involved. Extension lag was minimal in cases where only Thompson's quadricepsplasty was done. The extension lag recovered gradually in cases with Bennet's V-Y plasty was done. Conclusion: Quadriceps contracture is a common and very disabling condition. Various surgical options are available based on location of contracture, age, cause and duration of the contracture. Better results were obtained whenever surgery was done early. Physiotherapy is the main stay in the post operative management not only in gaining maximum flexion but also in regaining active extension.*

Keywords: Quadriceps contracture, Quadricepsplasty, Thompsons quadricepsplasty, Judets quadricepsplasty.

1. Introduction

Quadriceps contracture is a condition quadriceps is contracted due to various causes. The contracture may occur in one or more components of the muscle. Since the quadriceps femoris is the main active extensor of the knee, contracture of this muscle causes extension contracture of the knee thereby producing a stiff extended knee wherein the muscle fails to elongate enough to allow flexion. Apart from this extra-articular condition and other conditions producing stiff extended knee are adhesions of the capsule and synovial membrane (1-4).

As already mentioned contracture of quadriceps muscle cause stiff extended knee and flexion is limited to various degrees. This results in severe disability and individual as a whole especially in country like India where people sit on floor and squat for various purposes like working in the farms or for toilet. Hence it is important to obtain as much as flexion as possible without impairing the extending power of the quadriceps muscle(5-6)

Management of this condition is mainly surgical except for mild degrees of contractures where flexion of knee is more than 90°. The technique of releasing the adhesion and contractures in the quadriceps muscle is known as "QUADRICEPS PLASTY". There are various techniques described by various authors for quadricepsplasty (7-10).

The relative frequency of quadriceps contracture in this part of the world has prompted us to take up this study. The main aim of this study is to find out the etiology of the contracture. The component or components involved and treat it by suitable surgical technique and evaluate the results post-operatively.

2. Materials and Methods

Surgery is usually indicated in established cases of quadriceps contracture where conservative treatment is not beneficial. It is important to recognize and prevent quadriceps contracture early through passive exercise while child is receiving intra-muscular injections

Types of Surgical Methods

1) Distal Quadriceps Plasty

- Bennett's V-Y Plasty
- Thompson's Quadriceps Plasty

2) Proximal Release

- Judet's Proximal Release
- Sengupta's Proximal Release
- Lenart and Kullmann's proximal release of isolated rectus femoris contracture.

1) Distal Quadriceps Plasty

a) Bennett's V-Y Plasty

In this surgery originally devised by Bennett, the rectus femoris was lengthened to gain flexion.

Technique:

An antero-lateral incision is used to expose the rectus femoris. The skin and fascia are divided and rectus femoris is exposed. Then it is isolated from the vastus medialis and the lateralis in the distal third of the muscle. An inverted „V“ incision is made at the musculotendinous junction of the muscle. Then full flexion of the muscle is obtained or knee is forced into flexion to divide any capsules adhesion. Then the tendon is sutured back in the position of full flexion. Thus converting a „V“ to „Y“ of the incision. The wound is closed in layers after obtaining perfect hemostasis.

After Treatment:

The knee is immobilized in 90° flexion in an above knee cast for 2 weeks. Active mobilization is started afterwards.

The major disadvantage of this operation is the occurrence of extension lag.

b) Thompson's Quadriceps plasty:

Technique:

An anterior longitudinal incision is made through the skin and superficial fascia from proximal third of the thigh to the distal pole of the patella, the exact location of the incision depends on the location of any scars if present.

The deep fascia is divided along each side of the rectus femoris muscle from the proximal end of the skin incision to the patella and the muscle is separated from the vastus medialis and lateralis. Then the anterior part of the capsule of the knee joint including the lateral expansion of the vasti on both sides is divided far enough to overcome the contracture. The vastus intermedius is excised completely, which is usually a scarred band binding the posterior surface of rectus femoris and patella to the femur. A periosteal or fibrous covering is left over the anterior surface of the femur. If the tendon of the rectus femoris has been destroyed by the injury of the new tendon is created by making longitudinal incisions in the scar tissue in the distal third of thigh. At this point knee is slowly flexed to 110° to release the remaining intra-articular adhesions. If the vastus medialis and lateralis are badly scarred subcutaneous tissue and fat are interposed between vasti and the rectus femoris. If the vasti are relatively normal they are sutured to the rectus as far distally as the distal third of the thigh. Wound is then closed in layers after obtaining haemostasis.

If the flexion is still not obtained after correcting the first three cause then it must be due to shortening of the rectus femoris itself. In such cases the rectus femoris tendon must be lengthened but this should be avoided if possible because it always results in some loss of active extension.

After Treatment

The extremity is immobilized in a splint 50° less than the maximum flexion obtained at operation. This is maintained for 2- 3 days. The extremity is then placed in a continuous passive motion machine and the range of motion is began. Patient should remain in the hospital until he/she obtains a 90° passive flexion. Passive and active exercise for quadriceps is continued and are of critical importance to the success of this operation. The knee is kept in full extension in the night and is exercised during the day with active and active assisted exercises. If 90° of flexion is not obtained over after 3 months, gentle manipulation under anesthesia is done. Alternatively the limb is immobilized in above knee plaster of paris cast with knee in flexion 20° less than what was obtained at surgery for 2-3 weeks. Physiotherapy is started thereafter. The quadriceps power is regained very slowly.

2) Proximal Release

a) Judet's Proximal Release

Judet devised a muscle slide operation which avoids lengthening of the rectus femoris. In this operation, the vastus lateralis and vastus intermedius are released from their origin proximally. This eliminates chances of extension lag and haemarthrosis of the knee.

Technique:

Through an anteriomedial incision, the medial retinacula is freed, any intra-articular adhesions are released. The suprapatellar pouch is mobilized or excised via the intra-articular route. The knee is flexed and few degrees of flexion is gradually gained. Further flexion is prevented by the fibrosed quadriceps.

A long postero-lateral incision is made just lateral to the patella to 2.5cms below the greater trochanter. The vastus lateralis is completely freed from the linea aspera and from the greater trochanter with meticulous haemostasis the vastus intermedius is lifted extraperiosteally from the lateral and anterior surface of the femur. The vastus medialis is not disturbed. The rectus femoris is untouched. The wound is closed over suction drain.

After Treatment

Hips and knee are flexed to 90° under sedation over a box frame. Passive exercises are started at 48hrs when drain is removed. Active assisted exercises were started soon as possible usually 3 to 5 days.

b) Senguptha's Proximal Release

Sengupta modified Judet's proximal release. In this technique in addition to vastus lateralis release, the rectus femoris is also released from its origin, if it is contracted.

Technique:

A curved incision is made along the base of the greater trochanter and then vertically downwards along the lateral aspect of the thigh for a variable distance depending upon the extent of fibrosis. Through the upper part of the often-thickened ilio-tibial band is sectioned transversely. Then the upper attachment of the vastus lateralis below the trochanter is exposed, vastus lateralis is detached from the trochanteric line and then distally along lateral inter-muscular septum. As the vastus lateralis retracts to expose the vastus intermedius which is elevated using periosteal elevator from the femoral surface. Then knee is flexed to release the remaining adhesions. If the rectus component is also contracted, its origin is posed at the upper part of incision and detached after identifying and isolating the femoral nerve. After this full flexion should be possible. Then wound is closed in layers.

After Treatment

The limb is immobilized in above knee posterior slab with knee in maximum flexion. The splint is worn until the tenderness disappears usually for 3 to 4 weeks. Then vigorous quadriceps exercises are started, lag improves gradually and the patient can easily walk by four weeks and stand up from squatting position in 3 months.

c) Lenart and Kullman's Proximal Release Of Rectus Femoris

Lenart and Kullman described an operation to treat isolated contractures of rectus femoris.

Technique:

The incision begins below the anterior superior iliac spine and extends distally for several centimeters. The origin of rectus femoris is exposed both on antero-inferior iliac spine and over the acetabulum, when knee is flexed the muscle stretches like a cord. The origin of the muscle is detached from the anterior inferior iliac spine and over the acetabulum. The knee is flexed to 90° with the hip extended, the wound is closed in layers.

After Treatment

A hip Spica is applied with hip extended and the knee semi flexed. The plaster is removed after 4 weeks and active and passive exercises are begun.

Physiotherapy

Physiotherapy plays an important role in gaining flexion after surgery. Physiotherapy is also important for regaining power of quadriceps muscle and overcome the extensor lag. Normally it takes about 6 months to attain full recovery.

Isometric exercises of the quadriceps are started immediately after removal of sutures. The patient is trained to contract the quadriceps muscles as tightly as possible and sustain for few moments followed by relaxation. After mobilization of the knee intermittent dynamic and static quadriceps are advised upto 90° of flexion then gradually increasing the angle of flexion soon straight lag rising every five minutes. When good muscular control of the extremity is obtained the patient is allowed to walk with support and then allowed to bear weight gradually.

Active knee flexion and extension exercises with the knee flexed to 90° are carried out until the patient is able to extend the leg against gravity for 50 times. At this point progressively increasing amounts of weight are added to the foot and the patient works with each weight till he is able to achieve 50 repetitions to full extension while seated against resistance.

Non-weight bearing exercises consists of pool therapy, cycling, knee exercises self-assisted flexion exercises.

3. Discussion

Quadriceps contracture produces stiff extended knee where in there is limitation of flexion to variable degrees depending upon the severity of contracture. One or more components of the muscle may be involved in contracture and fibrosis leading to shortening of the muscle thus limiting flexion. The main components involved are in the midline of the limb namely Vastus intermedius and Rectus femoris(1-5)

As already described the exact cause of this condition is still obscure. It may be idiopathic or secondary to various conditions like intramuscular injections into the thigh, trauma to the quadriceps mechanism, and infection of soft tissues of the thigh or femur. The condition may be also due to muscular dysplasia of congenital origin as suggested by

Hnevkovsky, Fairbank and Barrett. The condition may be present since birth or manifest later in life (6-10).

In our series there were six patients in whom definite history regarding the causative factor could not be elicited. In nine patients there was definite history of receiving IM injections into thigh during infancy for various diseases. The commonest illness was gastroenteritis, respiratory tract infections and soft tissue infections of thigh. The duration of injection ranged from 3 days to 15 days. In most of the patients who received IM injections, swelling of the thigh followed injections, which resolved subsequently. The time of onset of limitation of flexion ranged from 6 months to 36 months. Two of these patients were born prematurely. The most common age of onset was between 2 and 6 years. This may be because at this stage the muscle fibers are more susceptible to irritant drugs.

The next important cause of quadriceps contracture in our series was trauma. 3 cases developed stiff extended knee following trauma. All three patients were between the age group 20-22 years when they sought medical advise. Two of these patients sustained blunt trauma to the anterior aspect of lower third of thigh and there was no history of fracture. In another 22-year-old male there was history operation for habitual dislocation of patella when he was eight years old after which he developed stiff knee.

In two other cases there was a history of abscess over the thigh in their early childhood, which burst open and healed subsequently.

Age Incidence

The average age incidence in our series is compared to the average age incidence in various other studies. The comparison is shown in table 1

Table 1

<i>Author</i>	<i>Average age in years</i>
Hnevkovsky (1961)	3.5
Gunn (1964)	5.8
Lloyd Roberts (1964)	6.5
A Karlen (1964)	
Natarajan (1971)	5.5
Bose and Chong(1976)	5.3
Ganguly and Singh (1982)	8.5
Our series (1994)	10.5

In our series the average age of presentation is high compared to that of the other workers. This is because the patient sought medical advice quite late even though the onset of limitation of flexion was at an earlier age.

Operative Findings

In our series vastus intermedius was contracted in 100% of the cases either alone or in association with other components. Vastus Intermedius alone was contracted in 25% of the cases. Vastus Intermedius and Rectus femoris were contracted in 25% of the cases. Vastus Intermedius, Rectus femoris and Vastus Lateralis ere involved in 35% of the cases. Vastus Intermedius and Vastus Lateralis were involved in 15% of the cases. The most commonly involved

structures were Vastus Intermedius and Rectus femoris. The contracted structures were found to be thin and atrophic. Table 2 shows the comparison of the structures involved with other series.

Table 2

Structures involved	Gunn (1964)	Natarajan (1968)	Jackson & Hutton (1985)	Our series (1994)
V.I	20%	85%	20%	100%
V.I + R.F	10%	5%	-	25%
V.I + V.L	50%	15%	5%	15%
R.F	10%	5%	55%	-
V.L	10%	10%	-	-
V.I + R.F + V.L	-	-	10%	35%

V.I: Vastus intermedius, R.F: Rectus femoris , V.L: Vastus lateralis

4. Operative Procedure Used and Results

In the present series Thompson's quadricepsplasty alone was done in 6 cases i.e. 30% of the cases and thompson's quadricepsplasty plus Bennet's V-Y plasty done in 14 cases i.e. 70% of the cases. The procedure was done depending upon the structures involved. Extension lag was minimal in cases where only thompson's quadricepsplasty was done. The extension lag recovered gradually in cases with Bennett's V-Y plasty was done. Table 3 shows the operative procedures and results compared with other studies.

Table 3

Author	Procedure	Excellent	Good	Fair	Poor
Hnevkovsky (1961)	Bennett's	0 %	70%	30%	-
Bose and Chong(1976)	Thompson's/Bennett's	55%	25%	20%	-
Mukharjee & A.K Das	Thompson's/Bennett's	15%	60%	10%	5%
Jackson & Hutton (1985)	Thompson's	45%	45%	10%	-
Our series(1994)	Thompson's/Bennett's	10%	40%	45%	5%

5. Conclusion

Quadriceps contracture is a condition quadriceps is contracted due to various causes. Various surgical options are available based on location of contracture, age , cause and duration of the contracture. Better results were obtained whenever surgery was done early and also helped in preventing secondary adoptive changes in soft tissues, cartilage and bones. Physiotherapy is the main stay in the post operative management not only in gaining maximum flexion but also in regaining active extension. This takes place gradually in about 6 months to 1 year.

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